TITLE OF THE INVENTION

IMAGING APPARATUS

5   ### BACKGROUND OF THE INVENTION

Field of the Invention

[0001]   The present invention relates to an imaging
apparatus such as a digital video camera or the like.

10   ### Description of the Related Art

[0002]   Images taken by conventional imaging apparatuses
(digital video camera or the like) can be recorded on an
internal recording medium such as a videotape.

[0003]   However, such conventional imaging apparatuses

15   have the disadvantage that the user is required to keep in
mind the remaining tape length of the internal recording
medium thereof at all times, and further have the
disadvantage that there is the need to stop recording of
images during replacement of a videotape or the like.

20   [0004]   Furthermore, there is the need to perform
switching for recording of images, in a manual mode
according to the decision of the user, even in the event
that the imaging apparatus is connected externally through a
network, leading to troublesome operations for the user, and

25   further leading to a problem that image-taking quality might

be adversely affected due to the user being distracted by such a troublesome switching operation.

[0005]   As described above, the conventional imaging apparatuses have a problem that in the event that the images cannot be recorded on an internal recording medium during image taking, it is difficult to continuously record the taken images.

SUMMARY OF THE INVENTION

[0006]   An object of the present invention is to overcome the above-described drawbacks. It is another object of the present invention to provide an imaging apparatus wherein the recording medium for recording taken images can be easily switched from an internal recording medium included in the imaging apparatus to a recording medium included in an external recording device.

[0007]   An imaging apparatus for recording taken images on an internal recording medium according to a preferred embodiment of the present invention comprises: a first detecting unit for detecting the remaining available recording space of the internal recording medium; a second detecting unit for detecting external recording devices communicably connected through a network in the event that the remaining available recording space of the internal

recording medium reaches a predetermined value; and a control unit for automatically performing switching of the recording medium for recording the taken images from the internal recording medium to a recording medium included in the external recording device detected by the second detecting unit.

[0008]   Further objects, features and advantages of the present invention will become apparent from the following description of the preferred embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]   Fig. 1 is a diagram which illustrates an example of a network configuration according to a first embodiment.

[0010]   Fig. 2 is a block diagram which shows an example of the internal configuration of a DVC serving as an imaging apparatus according to the first embodiment.

[0011]   Fig. 3 is a flowchart for describing an example of principal processing for switching of the recording medium for recording taken images from an internal recording medium to a recording medium in an external recording device.

[0012]   Fig. 4 is a flowchart for describing an example of processing for determining an external recording device for recording the taken images.

[0013]   Fig. 5 is a diagram which shows an example of a table for registering the order of the external recording devices for recording.

[0014]   Fig. 6 is a timechart for describing specific processing for switching of the recording medium from the internal recording medium to the recording medium included in the external recording device.

[0015]   Fig. 7 is a flowchart for describing specific processing for switching of the recording medium from the internal recording medium to the recording medium included in the external recording device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

First Embodiment

[0016]   Description will be made regarding a first embodiment according to the present invention with reference to the drawings. Fig. 1 is a network configuration diagram according to the first embodiment. Note that a network shown in Fig. 1 is stipulated by UPnP (Universal Plug and Play) (reference: Universal Plug and Play Device Architecture, Version 1.0, 08 Jun. 2000).

[0017]   In Fig. 1, reference numeral 301 denotes a DVC (Digital Video Camera). Reference numeral 302 denotes an IEEE 1394 cable serving as a digital interface. Reference

numeral 303 denotes an internal tape. Reference numeral 304

denotes a first AVHDD (Hard Disk, AVHDD 1), 305 denotes a

second AVHDD (Hard Disk, AVHDD 2), and 306 denotes a third

AVHDD (Hard Disk, AVHDD 3). Note that the first through

third AVHDDs 304 through 306 will be referred to as

"external recording devices" hereafter.

[0018]   As shown in Fig. 1, the DVC 301 is connected to

the first through third AVHDDs 304 through 306 via the IEEE

1394 cable 302, thereby enabling mutual input/output of

images.

[0019]   The DVC 301 has an internal tape 303 serving as an

internal recording medium. In general, images are taken

from a lens provided to the DVC 301, are converted into

image data in the DV format, and are recorded on the

internal tape 303.

[0020]   Fig. 2 is a block diagram which shows the internal

configuration of the DVC 301. In Fig. 2, reference numeral

401 denotes a camera, 402 denotes a signal processing

circuit, 403 denotes a display unit, 404 denotes a tape

control circuit, 405 denotes a UPnP control unit, 406

denotes an IEEE 1394 input/output circuit, and 407 denotes a

system controller. Note that solid lines show signal flow

and broken lines show data flow in Fig. 2.

[0021]   While it is needless to say that DVC 301 includes

an audio circuit so as to record audio, description of the

audio circuit will be omitted for simplification in the first embodiment. Note that it is needless to say that the audio circuit performs the same processing as with the video circuit.

[0022]   The images taken by the camera 401 are converted into image data in a predetermined format for recording on the internal tape 303 by the signal processing circuit 402, and are transmitted to the tape control circuit 404. Furthermore, the images taken by the camera 401 are transmitted to the display unit 403 and the IEEE 1394 input/output circuit 406, as well. Note that the images taken by the aforementioned camera 401 will be referred to as "taken image" hereafter.

[0023]   The user can record desired images while observing taken images displayed on the display unit 403. Upon the user starting recording of the taken images, the information is transmitted to the system controller 407. The system controller 407 commands the tape control circuit 404 to record the taken images on the internal tape 303.

[0024]   The tape control circuit 404 performs joining processing such as timecode processing, and servo processing, so as to perform recording in a suitable format, and so as to perform processing for correctly recording the taken image on the internal tape 303.

[0025]   Furthermore, the tape control circuit 404 reads

out the information with regard to the current recording

position (current position on the tape for recording) as to

the entire space of the internal tape 303 in order to obtain

the information with regard to the remaining tape length of

5   the internal tape 303, and transmits the information to the

system controller 407.

[0026]   The system controller 407 calculates the remaining

available recording time based upon the received information

with regard to the current recording position on the tape,

10   and displays the calculated remaining recording time on the

display unit 403. Note that the system controller 407

displays the aforementioned remaining recording time in a

user-friendly format.

[0027]   Furthermore, the tape control circuit 404 controls

15   a detecting circuit for detecting an abnormal state of the

internal tape 303 which is referred to as "jamming", and

detecting the presence or absence of the internal tape 303.

In the event that the abnormal state of the internal tape

303 is detected, the information is transmitted to the

20   system controller 407 with the highest priority.

[0028]   Now, description will be made regarding an example

of the principal process for switching the recording medium

for recording the taken images from the internal tape 303 to

an external recording device, with reference to the

25   flowchart shown in Fig. 3.

[0029]   First, the tape control circuit 404 confirms the presence of the internal tape 303 (Step S1), following which the tape control circuit 404 further confirms whether or not the internal tape 303 is available for recording images (Step S2).

[0030]   In the event that the internal tape 303 is available for recording, the tape control circuit 404 displays the information with regard to the internal tape 303 on the display unit 403, and records the taken images on the internal tape 303 (Step S3).

[0031]   On the other hand, in the event of absence of the internal tape 303 (Step S1), the tape control circuit 404 transmits the information regarding the absence of the internal tape 303 to the display unit 403 (Step S4).

[0032]   Furthermore, in the event that the internal tape 303 is not available for recording image data, a recording-image flag for starting recording images on an external recording device is set to on (Step S5).

[0033]   Subsequently, the system controller 407 commands the UPnP control unit 405 to issue a command for searching for external recording devices connected within the network (Step S6).

[0034]   In the event of detecting the devices available as an external recording device as a result of detection by the UPnP control unit 405, the UPnP control unit 405 transmits

this information to the system controller 407 (Step S7).

[0035]   The system controller 407 sends query commands for the remaining available recording space of external recording devices to the UPnP control unit 405 in the order of detection.

[0036]   The UPnP control unit 405 issues a command for detecting the aforementioned external recording device so as to measure the time period from issuing of the command up to reception of the response (response time). The UPnP control unit 405 transmits the information with regard to the measured time period and the available recording space of the aforementioned external recording device to the system controller 407 (Steps S8 and S9).

[0037]   The system controller 407 determines the optimal external recording device based upon the above-described notified information regarding the response time and available recording space of the aforementioned external recording device, and stores the order of priority of the external recording devices for performing recording of taken images (Step S10).

[0038]   In the event that the recording flag for recording on the external recording device is on (Step S11), the system controller 407 issues a recording command for the UPnP control unit 405 so that the external recording device can immediately starts recording of the taken images (Step

S12).

[0039]   In the event that there are no corresponding
available external recording devices in the network (Step
S7), the system controller 407 notifies the display unit 403
that there are no devices available for recording the taken
images in the UPnP network (Step S13), and sets the
recording flag for recording on the external recording
device to off (Step S14).   Furthermore, the system
controller 407 cancels the recording-start request specified
by the user, and notifies the display unit 403 that
recording cannot be made.

[0040]   Next, description will be made regarding a
specific process for determining the order of the external
recording devices for recording (the process for determining
the order of priority of the external recording devices for
recording the taken image in Step S10 shown in Fig. 3), with
reference to the flowchart shown in Fig. 4.

[0041]   First, the system controller 407 makes a
comparison between the response time periods from external
recording devices, as well as making a comparison between
the remaining available recording spaces thereof, and
determines the optimal device based upon the comparison
results (Step S21).

[0042]   In the event that a recording request for the
taken images is made without an available internal recording

medium such as the internal tape 303 or the like (Step S22),

there is the need to immediately start recording, and

accordingly, the system controller 407 determines the

priority of the external recording devices in the order of

5   the smallest response time therefrom (Steps S23 through S25).

[0043]   On the other hand, in the event that the taken

images are being recorded at that very time (Step S22), the

system controller 407 determines the priorities of the

external recording devices in the order of the greatest

10   remaining available recording space thereof in order to

reduce the number of times of switching of recording medium

of taken images (Steps S24 through S28).

[0044]   The system controller 407 has a table for the

external recording devices with the priorities thereof.

15   Furthermore, the system controller 407 adds new external

recording devices, which have been just added to the UPnP

network, to the group which is to be subjected to comparison

processing for determining the priorities based upon the

information obtained from the UPnP control unit 405.

20   [0045]   Accordingly, in the event that a new external

recording device has been added on the network, the system

controller 407 sends a query command to the aforementioned

new added external recording device so as to obtain the

above-described information regarding the response time

25   therefrom and the remaining available recording space

thereof. Subsequently, the system controller 407 appends the above-described information to a new table without including the external recording device which is currently being used for recording.

[0046]   It is needless to say that in the event that any external recording device is disconnected from the UPnP network, the information regarding the external recording device is deleted from the table included in the system controller 407, whereby the aforementioned table is updated. Fig. 5 shows an example of the table for storing the order of the external recording devices for recording.

[0047]   In the event that internal tape 303 is available for recording the taken image, immediately following a recording start request from the user, recording is started on the internal tape 303 in a suitable format (Steps S2 and S3 in Fig. 3).

[0048]   Note that the search is performed for the external recording devices on the aforementioned UPnP network while recording the taken images on the internal tape 303. Thus, the system controller 407 builds a table 50 regarding the external recording devices with priorities based upon the above-described search results.

[0049]   As described above, the system controller 407 calculates the aforementioned remaining available recording time based upon the aforementioned tape position detected by

the tape control circuit 404. Subsequently, the system controller 407 makes a comparison between the calculated remaining available recording time and the response time of the external recording device required for the start of

5 recording. The response time periods of the external recording devices required for the start of recording are registered in the table 50 regarding the external recording devices with the priorities thereof shown in Fig. 5 (the "response time for start of recording" in Fig. 5).

10 [0050] Description will be made below regarding a specific process for switching from recording the taken images on the internal tape 303 to recording the taken images on an external recording device, with reference to the timechart shown in Fig. 6 and the flowchart shown in Fig.

15 7.

[0051] The system controller and the like shown in Fig. 6 are the same components as in Fig. 2. On the other hand, the external recording device is any one of the AVHDDs 304 through 305 shown in Fig. 1. The display unit 403 displays

20 the taken images during recording of taken images on the internal tape 303. Note that the system controller 407 obtains the information regarding the state of the internal tape 303 at all times.

[0052] In the event that the remaining available

25 recording time corresponding to the remaining tape length of

the internal tape 303 reaches the sum of the response time of the external recording device with the highest priority registered in the table 50 and about ten seconds (Steps S31 and S32), the system controller 407 controls the display

5   unit 403 to makes a display to notify the user that recording medium for recording the taken images is switched to recording medium in the external recording device (point T801).

[0053]   In the event that the user confirms the display,

10   and determines that the taken images should not be recorded on any recording medium other than the internal tape 303, the user makes a request to stop recording. In the event that the system controller 407 does not receive such a request, the system controller 407 refers the table 50 (Step

15   S33), and issues to the external recording device a command for making a request for the start of recording of the taken images so that the remaining available recording time of the internal tape 303 includes the response time of the external recording device required for the start of recording (point

20   T802, Steps S34 through S37).

[0054]   In accordance with the external recording device receiving the request for the start of recording of the aforementioned taken images, the external recording device makes preparation for recording the taken images, and

25   records the input taken images on the internal recording

medium thereof.

[0055]   On the other hand, at the time of the start of recording on the external recording device, the display unit 403 makes a display to notify the user that the recording medium for the taken images has been switched from the internal tape 303 to the external recording device (point T803).   Note that the display on the display unit 403 is switched at the time of the recording device for the taken images having been actually switched from the internal tape 303 to the external recording device.

[0056]   In some cases, the system controller 407 might not be able to obtain the precise remaining tape length of the internal tape 303, or the obtained response time of the external recording device required for the start of recording might contain some margin of error.   In this case, the system controller determines the timing for issuing a command for the start of recording the taken images on the external recording device, with the maximal response time period of 30 seconds stipulated by the UPnP as the response time of the external recording device.

[0057]   The time from the external recording device receiving the command up to the start of recording does not always match the response time obtained by the UPnP control unit 404.   Accordingly, there is the need to determine the timing for issuing a command for making a request for the

start of recording of the taken images, taking the remaining available recording time and some degree of irregularity in the response time into consideration.

[0058] With the first embodiment, the same taken images are recorded both on the last portion of the internal tape 303 and the beginning portion of the recording medium included in the external recording device, thereby enabling continuous recording of the images taken by the user in a sure manner. That is to say, this method prevents occurrence of unrecorded images in the images taken by the user, in a sure manner.

[0059] In this case, with the first embodiment, the timing of switching of recording medium is determined based upon the maximal response time for a command (30 seconds in UPnP). That is to say, in the event that the response time of the external recording device required for the start of recording, registered in the table 50, is less than 30 seconds, a series of processing for switching of recording medium is started 30 seconds before the point that the remaining available recording space of the internal tape 303 becomes zero.

[0060] On the other hand, in a case that the response time of the external recording device required for the start of recording, registered in the table 50, is equal to or greater than 30 seconds, in the event that the remaining

available recording time reaches the sum of the response
time of the external recording device registered in the
table 50 and about five seconds, a series of processing for
switching of recording medium is started. Thus, the
5   recording medium for recording the taken images can be
smoothly switched from the internal tape 303 to the
recording medium of the external recording device.

[0061]   Note that in the event that external recording
devices are available for recording the taken images, and
10   the system controller 407 can obtain the remaining available
recording space or the remaining available recording time,
for all the external recording devices, an arrangement may
be made wherein the recording device for recording the taken
images is switched from an external recording device to
15   another external recording device.

[0062]   In this case, in the event that external recording
devices are connected on the UPnP network, the external
recording devices are registered in the table 50 with the
priorities thereof.

20   [0063]   The system controller 407 calculates the remaining
available recording time and the response time required for
the start of recording in the order of the external
recording device with the highest priority, and issues a
command for making a request for the start of recording of
25   the taken images to another external recording device

selected by the system controller 407, whereby switching of
the recording medium for recording taken images to a
recording medium in another external recording device
selected by the system is performed.

[0064]   In some cases, any of the devices might be
disconnected from the UPnP network. Accordingly, in the
event that any device does not send periodic messages to the
system controller 407, or in the event that the period of
validity, described in the message, has expired, the system
controller 407 is required to delete the registration of the
external recording device from the table 50.

[0065]   Accordingly, in some cases, there is the need to
perform an operation for switching of recording within the
term of validity described in the message after reception of
the message. In the event that the external recording
device, to which switching of the recording device is to be
performed, has been disconnected from the UPnP network,
switching of the recording device for recording taken images
cannot be made. In this case, even in the event that the
system controller 407 issues a command to the external
recording device with the next priority, there might be
unrecorded images, which have not been recorded in any
recording medium.

[0066]   Accordingly, in the event that external recording
devices are connected on the UPnP network (Step S34), the

system controller 407 is required to search the UPnP network
for the external recording devices again, so as to update
the table with regard to the external recording devices
available for recording images, prior to the process for
5   switching of the recording medium for recording taken images,
(Steps S35 and S36).

[0067]   In normal recording, switching of the recording
medium for recording the taken images can be made with the
above-described method. However, in the event that
10   malfunctioning occurs in the internal tape 303 or the
external recording device, switching of recording medium
must be immediately performed for the taken images. Even in
this case, there is the need to suppress unrecorded images
to a minimum.

15   [0068]   In the event that the table 50 regarding the
external recording devices have been built, and the external
recording devices are connected on the UPnP network, the
system controller 407 issues a command for making a request
for the start of recording of the taken images to the
20   external recording device having the smallest response time
required for the start of recording.

[0069]   Furthermore, at the same time, the system
controller 407 searches the UPnP network for the external
recording devices. In the event that the system controller
25   407 detects a new external recording device which can start

recording of the taken images with a response time shorter than with the external recording device registered in the table 50, the system controller 407 issues a command for making a request for the start of recording of the taken

5   images to the aforementioned newly detected external recording device in the same way as described above.

[0070]   In this case, recording of the same images is started on both of these two external recording devices. As a countermeasure, in the event that switching of recording

10   medium of the taken images on the external recording device registered in the table 50 at the time of occurrence of malfunctioning has been successfully performed, recording of the taken images on the newly detected external recording device is stopped. Subsequently, the system controller 407

15   issues a command to the newly detected external recording device for the recording position thereof to return to the position corresponding to the beginning of the aforementioned recorded images.

[0071]   Furthermore, in the event that the system

20   controller 407 can delete the images recorded on the aforementioned newly detected external recording device, the system controller 407 issues a command to the aforementioned newly detected external recording device for deleting the images recorded thereon which have also been recorded on

25   another external recording device. Subsequently, the system

controller 407 searches the UPnP network for the external

recording devices again, so as to update the table 50 for

the next switching of recording medium.

[0072]   On the other hand, in the event that

5   malfunctioning is eliminated, and the internal tape 303

becomes available for recording, switching of recording

medium for recording the taken images is made from the

recording medium included in the external recording device

to the internal tape 303, and the table 50 is updated

10   regarding the external recording devices with the updated

priorities.

[0073]   As described above, with the first embodiment, in

the event that the remaining recording space of the internal

tape 303 becomes smaller than a predetermined value during

15   recording the taken images on the internal tape 303 included

in the DVC 301, the system controller 407 issues a command

for recording the taken image to the AVHDD (external

recording device) so that switching of the recording medium

for recording the taken images is performed from the

20   internal tape 303 to any of the AVHDDs (external recording

devices) 304 through 306. That is to say, in the event that

the remaining recording space of the internal tape 303

becomes smaller than the predetermined value, switching of

the recording medium for recording the taken images can be

25   automatically performed. Thus, in the event that the

remaining recording space of the internal tape 303 becomes
small, switching of the recording medium for recording the
taken images can be easily performed in a sure manner.

[0074]   On the other hand, with the first embodiment, in
the event that a problem occurs that recording of the same
taken images is started on both the two external recording
devices, the system controller 407 issues, to the external
recording device which has not been registered in the table
50 at the time of occurrence of malfunctioning, a command
for stopping recording of the taken images, a command for
the recording position thereof to return to the position
corresponding to the beginning of the aforementioned
recorded images, and further issues a command for deleting
the aforementioned recorded images which have been also
recorded on another recording medium, thereby preventing the
same images from being recorded on the two recording devices.

[0075]   Furthermore, the system controller 407 obtains the
available recording space of each external recording device,
registers the information in the table 50, and determines
the recording device for recording the taken image based
upon the information registered in the table 50, and thus,
recording of the taken images can be performed for a long
time, and furthermore, the number of times of switching of
recording medium of the taken images can be reduced to a
minimum.

[0076]   Furthermore, the system controller 407 obtains the response time of each external recording device required for the start of recording (response time), registers the information in the table 50, and determines the recording

5   device for recording the taken image based upon the information registered in the table 50, and thus, in the event that malfunctioning occurs in the recording device during recording of the taken images, the system controller 407 selects an external recording device having the minimal

10   response time based upon the table 50 so as to perform switching of recording medium of the taken images as quickly as possible. Thus, the system controller 407 can suppress occurrence of unrecorded images due to malfunctioning of the recording device or the error of the user, to a minimum.

15   [0077]   While a method is preferably employed as with the first embodiment wherein the system controller 407 issues a command to the external recording device for the start of recording within the remaining available recording time of the internal tape 303 so that the same images are recorded

20   on the last portion of the internal tape 303 and the beginning portion of the external recording device, thereby enabling continuous recording of the images taken by the user in a sure manner, an arrangement may be made wherein the external recording device starts recording of the taken

25   images at the time of the remaining recording time of the

internal tape 303 becoming zero.

[0078]   Note that while in the first embodiment,
description has been made only regarding images, and
description regarding audio has been omitted, an arrangement
may be made wherein switching of recording medium of audio
is performed in the same way. The digital interface
employed in the present invention is not restricted to an
IEEE 1394 interface, but rather, any interface may be
employed as long as synchronous communication of image data
and audio data can be performed using the interface.

Second embodiment

[0079]   The present invention encompasses an arrangement
wherein software program codes are provided to a computer
within an apparatus or a system connected to the above-
described devices so as to operate the devices and effect
the functioning in the same way as with the above-described
first embodiment according to the program stored in the
computer (CPU or MPU) of the system or the apparatus.

[0080]   In this case, the aforementioned software program
codes effect the functioning in the above-described first
embodiment, and the program codes, and means for providing
the program codes to a computer, e.g., a recording medium
storing the program codes, are included in the present
invention. As a recording medium for storing the program
codes, a flexible disk, hard disk, optical disk, magneto-

optical disk, CD-ROM, magnetic tape, non-volatile memory card, ROM, or the like, may be employed, for example.

[0081] Furthermore, it is needless to say that the program codes are included in the present invention, not only in a case of an arrangement wherein a computer effects the functioning in the same way as with the above-described embodiment by executing the provided program codes, but also in a case of an arrangement wherein the program codes effect the functioning in the same way as with the above-described embodiment in cooperation with an OS (operating system) operating on the computer, application software other than the OS, or the like.

[0082] Furthermore, it is needless to say that an arrangement is included in the present invention wherein provided program codes are stored in memory included in a function expansion board of a computer or a function expansion unit connected to the computer, following which a CPU or the like included in the function expansion board or the function expansion unit executes a part of or all of the actual processing according to the instructions from the program codes so as to effect the functioning in the same way as with the above-described embodiment.

[0083] While the present invention has been described with reference to what are presently considered to be the preferred embodiments, it is to be understood that the

invention is not limited to the disclosed embodiments. On the contrary, the invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.